LONDON-WEST MIDLANDS ENVIRONMENTAL STATEMENT

Volume 5 | Technical Appendices

CFA11 | Stoke Mandeville and Aylesbury

Water resources assessment (WR-002-011)

Water resources

November 2013

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Department for Transport

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1 Introduction

1.1 Structure of the water resources and flood risk assessment appendices

1.1.1 The water resources and flood risk assessment appendices comprise four parts. The first of these is a route-wide appendix (Appendix WR-001-000).

1.1.2 Specific appendices for each community forum area (CFA) are also provided. For the Stoke Mandeville and Aylesbury area (CFA11) these are:

- a water resources assessment (i.e. this appendix);
- a flood risk assessment (Appendix WR-003-011); and
- a hydraulic modelling report for the Stoke Brook (Appendix WR-004-003).

1.1.3 Maps referred to throughout the water resources and flood risk assessment appendices are contained in the Volume 5, Water Resources and Flood Risk Assessment Map Book.

1.2 Study area

1.2.1 The spatial scope of the assessment was based upon the identification of surface water and groundwater features within 1km of the centre line of the Proposed Scheme, except where there is clearly no hydraulic connectivity and in urban areas where the extent was 500m, as outside of these distances it is unlikely that direct impacts upon the water environment will be attributable to the Proposed Scheme. Where works extend more than 200m from the centre line, for example at new or realigned roads, a professional judgement was made in selecting the appropriate limit to the extension in spatial scope. For the purposes of this assessment this is defined as the study area.

1.2.2 The study area covers approximately 10.5km of the Proposed Scheme, extending from south of Stoke Mandeville to the A41 Bicester Road near Cranwell Farm. The study area comprises a predominantly rural landscape of mixed agricultural use. The topography is characterised by a series of gently undulating vales.

1.2.3 The main environmental features of relevance to water resources comprise:

- the River Thame and its associated floodplain;
- the Stoke Brook, that is a main river and its tributaries;
- the Sedrup Ditch and Lower Hartwell Ditch, that are main rivers and their tributary streams close to Lower Hartwell;
- tributaries of the Fleet Marston Brook;
- a number of small brooks, field drains and ponds within 1km of the study area, including the Bear Brook, and a landscape which includes several watercourses and ponds between Upper and Lower Hartwell; and

- the Portland Group Principal aquifer and a number of Secondary aquifers.

1.2.4 Key environmental issues relating to water resources include:

- potential short term impacts on surface water flows and quality as a result of construction works on and over, or in close proximity to:
  - the Stoke Brook and tributaries at Stoke Mandeville;
  - the River Thame and tributaries at Aylesbury; and
  - tributaries of the Fleet Marston Brook west of Fleet Marston.
- the potential impact to surface water flow and quality as a result of diversions, culverts and crossings associated with the Stoke Brook and River Thame; and
- the potential impact on groundwater quality and private groundwater abstractions associated with aquifers in the Lower Greensand, Purbeck and Portland Groups (known collectively as the Headington Corallian).

1.2.5 Where there is a residual impact to water resources and following mitigation there is a consequent effect on ecology, this is discussed further in Volume 2, CFA Report 11, Section 7.

2 Stakeholder engagement

2.1.1 Discussions have been held with:

- the Environment Agency to inform the water resources assessment;
- Aylesbury Vale District Council and Wycombe District Council regarding private unlicensed abstractors;
- the Canal & River Trust (formally British Waterways); and
- private licensees by way of a questionnaire requesting further information, or a meeting, in order to assess more accurately and understand any potential risks to private abstractions.

3 Baseline data

3.1 General

3.1.1 The following sub-sections provide a current description of water resources including surface water and groundwater.

3.1.2 All water bodies in this area fall within the Thame and South Chilterns sub-catchment of the Thames River Basin District as defined under the Water Framework Directive[1] (WFD) and are covered by the River Basin Management Plan[2] (RBMP).

3.2 Surface water

3.2.1 All surface water features within 1km of the route are presented in Table 1.

3.2.2 The current surface water baseline is shown on Map WR-01-014 and Map WR-01-015 (Volume 5, Water Resources and Flood Risk Assessment Map Book). If the feature has a specific reference number then this is provided (e.g. a surface water crossing will be referenced as SWC-CFA14-01). If the feature has no specific reference its location on a specific map is provided (e.g. WR-01-014, D6) where D6 is a grid reference using the map specific grid.

3.2.3 The surface water features are based on the Environment Agency's Detailed River Network (DRN) with the addition of water bodies noted on the Ordnance Survey's (OS) 'OS VectorMapDistrict'.

[1] European Parliament and European Council (2000). *Water Framework Directive - Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy*, Strasbourg, European Parliament and European Council.
[2] Environment Agency (2009) River Basin Management Plan, Thames River Basin District.

Table 1: Surface water features within 1km of the route in CFA11

Water feature	Location description (Volume 5 Water Resources and Flood Risk Map Book map reference)	Watercourse classification[3]	WFD water body and current overall status	WFD status objectives (by 2027 as in RBMP)	Receptor value[4]	Q95[5] (m^3/s)	Catchment area at crossing (km^2)	Notes
Unnamed pond	Unnamed pond adjacent to Stoke Brook on the CFA10/CFA11 boundary. (SWC-CFA11-17)	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	Isolated field pond not connected to any other surface water features. Aerial photos show it is heavily overgrown with vegetation (bushes).
Chalkshire Stream	Will be crossed by the route at the Nash Lee orchard footpath. (SWC-CFA11-01)	Main river	No status class shown in RBMP - assumed status Moderate	No status class shown in RBMP - assumed status Good	High	0.005	5.19	Will be crossed by route on the CFA10/CFA11 boundary flowing north-east before joining Stoke Brook
Stoke Brook	Will be crossed by the route and footpath at the Nash Lee orchard footpath. (SWC-CFA11-02 and SWC-CFA11-18)	Main river	Stoke Brook (Aylesbury), (GB106039030320) Moderate	Good (by 2015)	High	0.005	5.20	Will be crossed by route near the CFA10/11 boundary.

[3] Water-feature classifications: Section 113 of the Water Resources Act 1991 defines a main river as "a watercourse that is shown as such on a main river map". Section 72 of the Land Drainage Act 1991 defines an ordinary watercourse as "a watercourse that is not part of a main river". Section 221 of the Water Resources Act 1991 defines a watercourse as including '"all rivers and streams, ditches, drains, cuts, culverts, dikes, sluices, sewers (other than public sewers) and passages through which water flows". Main rivers are larger rivers and streams designated by Defra on the main river map and are regulated by the Environment Agency.

[4] For examples of receptor values see Table 43 in the Scope and Methodology Report (SMR) Addendum, Volume 5: Appendix CT-001-000/2.

[5] Derived from National River Flow Archive data and catchment areas calculated using the Flood Estimation Handbook - Centre for Ecology and Hydrology, (2009) Flood Estimation Handbook (FEH) CD-ROM Version 3.0. Q95 is the flow which is exceeded for 95% of the time (i.e. it is a low flow and the river will only have flows less than this for 5% of the time).

Water feature	Location description (Volume 5 Water Resources and Flood Risk Map Book map reference)	Watercourse classification[3]	WFD water body and current overall status	WFD status objectives (by 2027 as in RBMP)	Receptor value[4]	Q95[5] (m^3/s)	Catchment area at crossing (km^2)	Notes
Stoke Brook	Just to the east of the site of St Mary's Church. (SWC-CFA11-03, SWC-CFA11-19, SWC-CFA11-21 and SWC-CFA11-22)	Main river	Stoke Brook (Aylesbury), (GB106039030320) Moderate	Good (by 2015)	High	0.005	5.25	The Stoke Brook flows north-east to south-west through the CFA before joining the Bear Brook. It divides upstream of the A4010 Risborough Road into an artificial channel which flows through a mill pond at Stoke House (SWC-CFA11-03), and a smaller natural channel in the valley bottom which will be crossed by the route at SWC-CFA11-04, 05 and 06).The channel defined under the WFD as Stoke Brook is the artificial channel flowing past Stoke House.
Tributary of the Stoke Brook	Just to the east of the site of St Mary's Church and near Mill House Farm. (SWC-CFA11-04 to SWC-CFA11-06)	Ordinary watercourse	No status class shown in RBMP - assumed status Moderate	No status class shown in RBMP - assumed status Good	High	0.005	5.26	Original natural channel of the Stoke Brook (see SWC-CFA11-03).
Five small ponds, Stoke Mandeville	Isolated field ponds within Stoke Mandeville within 1km of the route. (CFA11-P01)	Not classified	Not applicable	Not applicable	Low	Not applicable	Not applicable	They are not connected to any other surface water features.

Water feature	Location description (Volume 5 Water Resources and Flood Risk Map Book map reference)	Watercourse classification[3]	WFD water body and current overall status	WFD status objectives (by 2027 as in RBMP)	Receptor value[4]	Q95[5] (m^3/s)	Catchment area at crossing (km^2)	Notes
Unnamed drain near Hall End	Isolated field drain and pond near Hall End to the west of Stoke Mandeville, approximately 540m north of the route. (SWC-CFA11-20)	Not classified	Not applicable	Not applicable	Low	Not applicable	Not applicable	The drain and pond are not obviously connected to any other surface water features.
Unnamed stream west of Standall's Farm	Small stream to the south of the proposed route near Standall's Farm, flowing south away from route into Scotsgrove Brook near Bishopstone.	Ordinary watercourse	No status class shown in RBMP - assumed status Poor	No status class shown in RBMP - assumed status Good	Moderate	Not applicable	Not applicable	Rises from issues just west of Standall's Farm
Unnamed pond at Standall's Farm	Located at Standall's Farm. (CFA11-P02)	Not classified	Not applicable	Not applicable	Low	Not applicable	Not applicable	Isolated pond with no evident surface water links.
Tributary of Sedrup Ditch	A field drain which will cross the route south of Aylesbury (SWC-CFA11-07, SWC-CFA11-23 and SWC-CFA11-24)	Ordinary watercourse	No status class shown in RBMP - assumed status Moderate	No status class shown in RBMP - assumed status Good	Moderate	0.002	1.63	The drain joins the Sedrup Ditch 300m south of SWC-CFA11-08.

Water feature	Location description (Volume 5 Water Resources and Flood Risk Map Book map reference)	Watercourse classification[3]	WFD water body and current overall status	WFD status objectives (by 2027 as in RBMP)	Receptor value[4]	Q95[5] (m^3/s)	Catchment area at crossing (km^2)	Notes
Sedrup Ditch	Sedrup Ditch flows northwards entering the Stoke Brook near the Oxford Road roundabout in Aylesbury. (SWC-CFA11-08, SWC-CFA11-25 and SWC-CFA11-26)	Main river	No status class shown in RBMP - assumed status Moderate	No status class shown in RBMP - assumed status Good	Moderate	0.002	1.71	A watercourse that will be crossed by the route south of Aylesbury. It flows northwards and joins Stoke Brook.
Unnamed drain alongside A418	Small drain running parallel with A418 and joining the Stoke Brook on the south-west side of Aylesbury, approximately 330m north of the route. (SWC-CFA11-27)	Ordinary watercourse	No status class shown in RBMP - assumed status Moderate	No status class shown in RBMP - assumed status Good	Moderate	0.001	Less than 0.5	Joins the Stoke Brook near the confluence with the Sedrup Ditch.
South Lower Hartwell Ditch and unnamed pond	Golf course south-east of Lower Hartwell. (SWC-CFA11-28) (CFA11-P03)	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	Isolated pond located 140m north of the route. The outlet, a small ditch, drains southwards to the line of the route.
Hartwell Ditch	Outlet from Hartwell House Lake. (SWC-CFA11-09)	Main river	No status class shown in RBMP - assumed status Moderate	No status class shown in RBMP - assumed status Good	Moderate	0.001	0.52	Flowing north-east/north before joining Stoke Brook to the north of the route.

Water feature	Location description (Volume 5 Water Resources and Flood Risk Map Book map reference)	Watercourse classification[3]	WFD water body and current overall status	WFD status objectives (by 2027 as in RBMP)	Receptor value[4]	Q95[5] (m^3/s)	Catchment area at crossing (km^2)	Notes
Lower Hartwell Ditch	Located at Aylesbury Park Golf Club. (SWC-CFA11-10, SWC-CFA11-29 and SWC-CFA11-30)	Main river	No status class shown in RBMP - assumed status Moderate	No status class shown in RBMP - assumed status Good	Moderate	0.001	0.93	Small field ditch will be crossed by the route south-west of Aylesbury, flowing north-east/north before joining Stoke Brook to the north of the route.
Unnamed drain north of Lower Hartwell Ditch	Drain north of Lower Hartwell Ditch Aylesbury Park Golf Club. (SWC-CFA11-11 and SWC-CFA11-31)	Ordinary watercourse	No status class shown in RBMP - assumed status Moderate	No status class shown in RBMP - assumed status Good	Low	0.001	Less than 0.5	Field drain will be crossed by the route south-west of Aylesbury. The drain flows into Lower Hartwell Ditch 140m north-east of the route.
Eleven unnamed ponds	Isolated field ponds and drains located within 900m of Lower Hartwell to the north and south of the route. (SWC-CFA11-32) (CFA11-P04)	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	A number of isolated field ponds. They are not connected to any other surface water features.

Water feature	Location description (Volume 5 Water Resources and Flood Risk Map Book map reference)	Watercourse classification[3]	WFD water body and current overall status	WFD status objectives (by 2027 as in RBMP)	Receptor value[4]	Q95[5] (m^3/s)	Catchment area at crossing (km^2)	Notes
Bear Brook	A tributary of the River Thame located 288m to the north of the route. It flows to the north-west and parallel to the route.	Main river	Bear Brook, Hartwell Ditch, at west Aylesbury (GB106039030350) Poor Bear Brook and Wendover Brook (GB106039030380) Moderate	Good Potential Good Potential	High High	Not applicable	Not applicable	Bear Brook rises near Wendover and flows though Aylesbury, where it is joined by Stoke Brook, before joining the River Thame to the north-west. Bear Brook will not be crossed by the route. It runs generally parallel to and north of the route. It is classified by the Environment Agency as an artificial small watercourse. The brook is split into two water bodies for the purposes of WFD.
Tributary of River Thame south of Bear Brook	Enters the River Thame on the left bank downstream of Bear Brook. (SWC-CFA11-12)	Ordinary watercourse	No status class shown in RBMP - assumed status Poor	No status class shown in RBMP - assumed status Good	Moderate	0.0002	0.18	The outflow from a small artificial pond located 310m east of the River Thame. It will be crossed by the route at SWC-CFA11-12.
River Thame	Will be crossed by the route west of Aylesbury. (SWC-CFA11-13)	Main river	Thame (Aylesbury to Scotsgrove Brook) (GB106039030370) Poor	Good	High	0.221	216.0	The River Thame is a medium sized river flowing in a south-west direction across the route.

Water feature	Location description (Volume 5 Water Resources and Flood Risk Map Book map reference)	Watercourse classification[3]	WFD water body and current overall status	WFD status objectives (by 2027 as in RBMP)	Receptor value[4]	Q95[5] (m^3/s)	Catchment area at crossing (km^2)	Notes
Fleet Marston Brook	Flows in a southern direction from west of Fleet Marston Farm, approximately 1km to the north of the route before joining the River Thame 45m north of SWC-CFA11-13.	Ordinary watercourse	Fleet Marston Brook, Denham Brook, Pitchcott, Brook west. (GB106039030420) Poor	Good status	High	0.063	61.2	Fleet Marston Brook rises north of Waddesdon and flows eastwards to join the River Thame. The natural drainage has largely been replaced with a network of field drains.
Unnamed drain south of Putlowes	Unnamed drain located 460m south of Putlowes. (SWC-CFA11-14)	Ordinary watercourse	No status class shown in RBMP - assumed status Poor	No status class shown in RBMP - assumed status Good	Moderate	0.001	Less than 0.5	The drain is said to in culvert and flows eastwards. The culvert will be crossed by the route about 60m upstream of where it joins the Fleet Marston Brook.
Unnamed drain at Putlowes	Drain flowing eastward from the route to Putlowes (SWC-CFA11-33 and SWC-CFA11-34)	Not classified	Not applicable	Not applicable	Low	0.001	Less than 0.5	The drain is marked as an isolated channel on Ordnance Survey (OS) mapping with no connectivity to the pond at Putlowes or the drainage network to the south of the route around Fleet Marston Spinney.
Putlowes Pond and outlet drain	Located to the south of the route (90m). The outlet drains to the Fleet Marston Brook. (CFA11-P05)	Ordinary watercourse	No status class shown in RBMP - assumed status Poor	No status class shown in RBMP - assumed status Good	Moderate	Less than 0.001	Less than 0.5	The outlet drains eastwards to join the Fleet Marston Brook 230m north-east of the route. There is a sluice located on the Fleet Marston Brook 32m downstream of the confluence with the outlet of the outlet drain.

Water feature	Location description (Volume 5 Water Resources and Flood Risk Map Book map reference)	Watercourse classification[3]	WFD water body and current overall status	WFD status objectives (by 2027 as in RBMP)	Receptor value[4]	Q95[5] (m^3/s)	Catchment area at crossing (km^2)	Notes
Unnamed drain from Coney Hill and Fleet Marston Spinney	The route will cross the field drain south of Fleet Marston Farm. (SWC-CFA11-15, SWC-CFA11-35 and SWC-CFA11-37)	Ordinary watercourse	No status class shown in RBMP - assumed status Poor	No status class shown in RBMP - assumed status Good	Moderate	0.0006	0.58	The route will cross a field drain 600m south of Fleet Marston Farm, flowing north before joining the Fleet Marston Brook to the north of the route.
Unnamed drain from Upper Cranwell Farms	Drain from Upper and Lower Cranwell farms. (SWC-CFA11-16 and SWC-CFA11-36)	Ordinary watercourse	No status class shown in RBMP - assumed status Poor	No status class shown in RBMP - assumed status Good	Moderate	0.0006	0.58	Joins the unnamed drain from Coney Hill and Fleet Marston Spinney 42m north of the route.
Five unnamed ponds	Isolated field ponds to the south of Fleet Marston within 1km of the route (90m). (CFA11-P06)	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	They are not connected to any other surface water features.

3.2.4 There are no surface water abstractions within 1km of the route in the study area[6]. There is the potential for further unlicensed abstractions to exist, as a licence is not required for abstraction volumes below 20m^3 per day.

3.2.5 The following table summarises surface water discharge consents within 1km of the route.

Table 2: Surface water discharge consents

Reference number	Permit identifier	Distance and direction from route (m)	Discharge type	Receiving water body
CFA11WD102	NPSWQD001825	226m (east)	Sewage discharge - final/treated effluent	Tributary of River Thame
CFA11WD23	CNTM.1003	484m (east)	Sewage discharge - final/treated effluent	Tributary of Stoke Brook
CFA11WD67	TEMP.0563	125m (west)	Sewerage network - pumping station	Hartwell Ditch
CFA11WD104	NPSWQD004742	400m (west)	Sewage discharge - final/treated effluent	Bear Brook
CFA11WD65	TEMP.2363	175m (east)	Public sewage - storm sewage overflow	River Thame
CFA11WD95	CSSC.0315	159m (west)	Sewage discharge - final/treated effluent	River Thame
CFA11WD96	CSSC.0315	632m (east)	Sewage discharge - final/treated effluent	River Thame
CFA11WD96	CSSC.0315	632m (west)	Sewage discharge - final/treated effluent	River Thame
CFA11WD98	CSSC.0315	159m (west)	Sewage discharge - final/treated effluent	River Thame
CFA11WD40	CTWC.2628	635m (east)	Sewage discharge - final/treated effluent	Fleet Marston Brook
CFA11WD3	CNTM.1092	622m(west)	Sewage discharge - final/treated effluent	Tributary of Fleet Marston Brook
CFA11WD9	CTCR.1365	175m (west)	Sewage discharge - final/treated effluent	River Thame
CFA11WD10	CNTW.0940	10m (west)	Storm/emergency overflow	Hartwell Ditch
CFA11WD12	CNTW.0427	652m (west)	Discharge of other matter - surface water	Stoke Brook
CFA11WD84	CAWM.1125	915m (west)	Sewage discharge - final/treated effluent	Haydon Ditch
CFA11WD85	CAWM.1126	915m (west)	Sewage discharge - final/treated effluent	Haydon Ditch

[6] Surface water abstractions for public supply are not included.

Reference number	Permit identifier	Distance and direction from route (m)	Discharge type	Receiving water body
CFA11WD86	CAWM.1127	915m (west)	Sewage discharge - final/treated effluent	Haydon Ditch
CFA11WD87	CAWM.1128	915m (west)	Sewage discharge - final/treated effluent	Haydon Ditch
CFA11WD88	CAWM.1129	915m (east)	Sewage discharge - final/treated effluent	Haydon Ditch
CFA11WD93	CAWM.1513	958m (west)	Sewage discharge - final/treated effluent	Tributary leading to Scotsgrove Brook
CFA11WD103	NPSWQD003751	734m (west)	Sewage discharge - final/treated effluent	River Thames
CFA11WD109	TEMP.2143	868m (west)	Sewage discharge - pumping station	Hartwell Ditch
CFA11WD110	TEMP.2180	537m (west)	Sewage discharge - pumping station	Sedrup Ditch

3.3 Groundwater

3.3.1 A summary of the geological units present in the study area, along with their hydrogeological characteristics, is presented in Volume 2, CFA Report 11, Section 8.

3.3.2 Map WR-02-011 (Volume 5, Water Resources and Flood Risk Assessment Map Book) indicates the spatial distribution of the uppermost superficial and bedrock formations in the area. A schematic cross-section along the line of the route in this area showing the geological strata and any known groundwater elevations and the vertical location of the scheme is presented in Figure 1.

3.3.3 Superficial deposits are absent over the majority of the study area. The limited superficial deposits located along the route comprise Secondary aquifers at the following locations:

- River Terrace Deposits (Secondary A aquifer) consisting of sands and gravels and Alluvium consisting of clay, silt and sand associated with the River Thame, Stoke Brook, Bear Brook and their tributaries; and
- four minor areas of Head Deposits (Secondary undifferentiated aquifer) consisting of silt, sand and clay, located to the north-east of Standall's Farm, at Lower Hartwell, south of Putlowes and at Fleet Marston.

3.3.4 The superficial aquifers are limited in area and depth and, as such, are unlikely to support any substantial groundwater abstractions. They are likely, however, to be in continuity with local watercourses where these cross them.

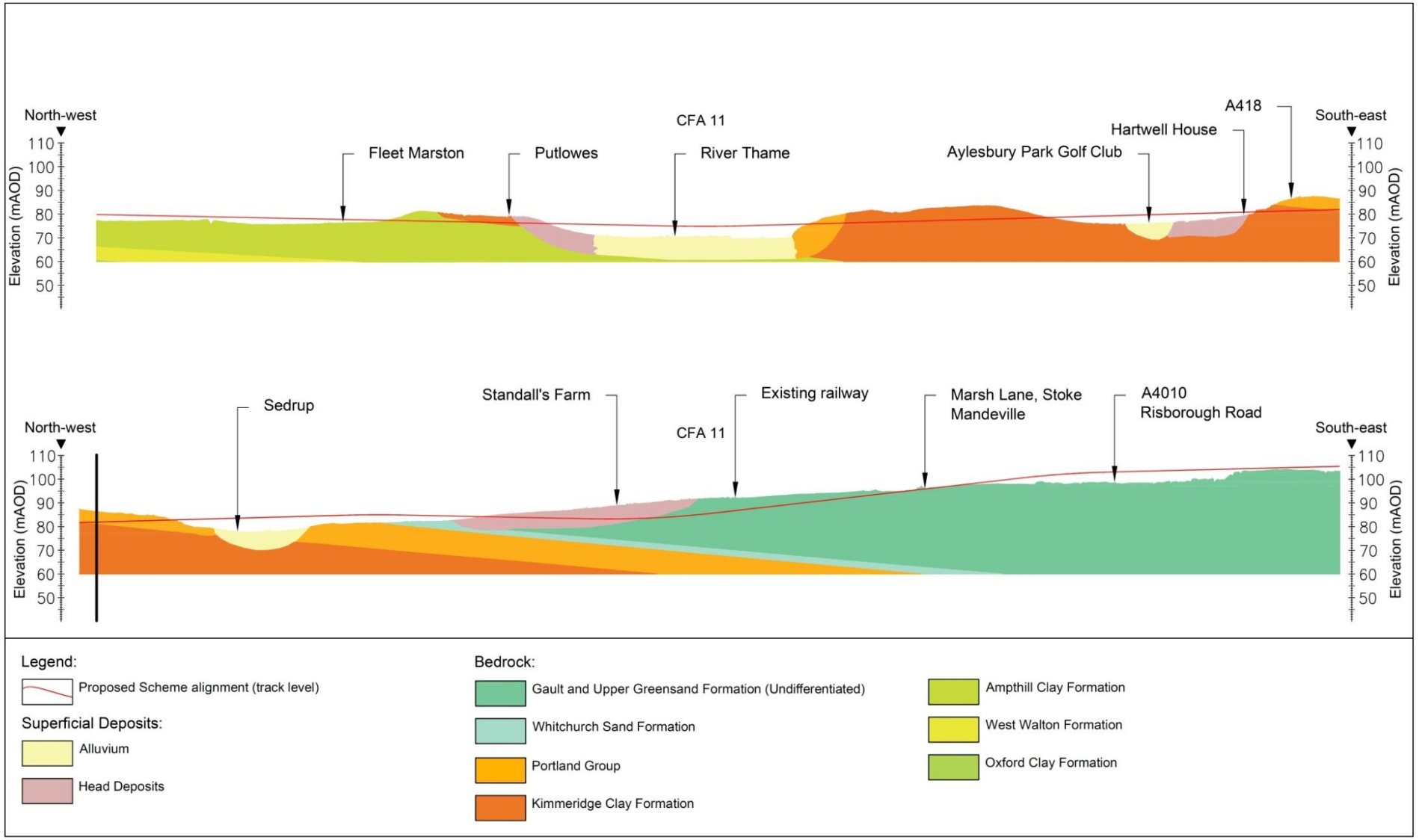
3.3.5 Generally, from south-east to north-west, the underlying bedrock comprises the following sequence:

- Gault Formation, or undifferentiated Gault and Upper Greensand Formation (Selbourne Group), comprising mudstones in the Gault and predominantly sandstones in the Upper Greensand;
- Wealden Group (sand, beds of sandstone, silt, clay and mudstone);
- Purbeck Limestone Group;
- Portland Group consisting of the Portland Stone and Portland Sand Formations; and
- Ancholme Group consisting of Kimmeridge Clay and Ampthill Clay, underlying the route from just north of the A418 road crossing to the CFA11/CFA12 boundary (about 5km).

3.3.6 In summary the southern half of the study area has some aquifers outcropping under the route but in the northern half of the study area the route will cross unproductive strata (non-aquifers).

3.3.7 The Lower Greensand, Portland and Wealden groups are referred to jointly as the Headington Corallian WFD water body and is covered by the Thames RBMP. The current status is Good and the WFD objective is to maintain Good Status by 2015.

Figure 1: Schematic geological cross-section for CFA11



3.3.8 There are no public water supply source protection zones (SPZ) located within 1km of the route. There is the potential for further unlicensed abstractions to exist, as a licence is not required for abstraction volumes below 20m^3 per day. Table 3 summarises licensed groundwater abstractions within 1km of the route.

Table 3: Licensed groundwater abstractions

Licence identifier (map reference number and Environment Agency reference)	Distance (and direction) from route (m)	Abstraction horizon	Maximum annual abstraction quantity (m^3)	Maximum daily abstraction quantity (m^3/d)	Purpose	Number of boreholes
Public water supplies						
None within 1km of route.						
Private licensed water supplies						
28/39/19/0108 (GW17)	695m (south-west)	Likely to be Portland Formation	1,181	Unknown	Unknown	1
28/39/19/0118 (GW18)	275m (north-east)	Likely to be superficial deposits	1,782	Unknown	Unknown	1
Private unlicensed water supplies						
No data held by local authority						

3.3.9 Table 4 summarises discharge consents to groundwater, directly or via land, within 1km of the route.

Table 4: Discharge consents to groundwater

Reference number	Permit identifier	Distance from route (m)	Discharge type	Receiving water body
CFA11WD91	CATM.2326	940m (north north-east)	Sewage discharges - final/treated effluent - not water company	Gault Clay (via irrigation)
CFA11WD92	CTCU.1166	665m (south south-west)	Sewage discharges - final/treated effluent - not water company	Portland Beds (to land)
CFA11WD99	CAWM.1571	740m (south-west)	Sewage discharges - final/treated effluent - not water company	Groundwater via soakaway
CFA11WD101	Npswqd00017 7	750m (south-west)	Sewage discharges - final/treated effluent - not water company	Groundwater via soakaway

3.4 Surface water/groundwater interaction

3.4.1 Table 5 summarises the surface water/groundwater interactions within 1km of the route.

Table 5 : Surface water/groundwater interaction

Location description	Distance from route (m)	Formation	Approximate elevation (m AOD)	Comments
Springs/issues				
South-east of Bishopstone (Map WR-02-11, G6)	645m (south-west)	Lower Greensand/ Gault Clay boundary	83m AOD	Issues feed into small streams that flow to the west.
South-east of Bishopstone (Map WR-02-11, G6)	830m (south-west)	Lower Greensand/ Gault Clay boundary	83m AOD	Issues feed into small streams that flow to the west.
Issues north-east of Bishopstone (Map WR-02-11, F6)	535m (south-west)	Close to the Lower Greensand/ Purbeck Group boundary	84m AOD	Issues feed into a stream that flows northwards, before joining other small streams and flowing north-east towards the Bear Brook.
Two issues at Sedrup (Map WR-02-11, F6)	540m (south-west) 765m (south-west)	Portland Sand/ Portland Stone Member boundary	83m AOD	Issues feed a small stream that flows south-east and may join other streams to the south, flowing south-east and eventually northwards towards the Bear Brook.
Spring at Calley Farm (Map WR-02-11, F6)	620m (south-west)	Portland Stone Member/Purbeck Group boundary	90m AOD	Spring feeds a small stream that flows south-east and may join other streams to the south, flowing south-east and eventually northwards towards the Bear Brook.
Spring, Egyptian Well (Map WR-02-11, E6)	475m (south-west)	Portland Formation	85m AOD	Spring feeds into a small stream that flows into the lake at Hartwell House and then eastwards to join other streams feeding the Bear Brook.
Emergence of Upper Hartwell stream (Map WR-02-11, E6)	675 m(south-west)	Portland Formation	88m AOD	Stream emerges and flows north, joining streams at Lower Hartwell that flow to the Bear Brook.
Issues at Lower Hartwell (Map WR-02-11, E6)	335m (south-west)	Appear within Kimmeridge Clay Formation	80m AOD	Issues flow into stream that flows to the east, then eventually into the Bear Brook.

Location description	Distance from route (m)	Formation	Approximate elevation (m AOD)	Comments
Emergence of two streams at Lower Hartwell (Map WR-02-11, D6)	155m (south-west) 110m (south-west)	Appear within Kimmeridge Clay Formation	78m AOD	Streams flow to the east, and then eventually flow into the Bear Brook.
Stream emergence north-west of Whaddon Hill Farm (Map WR-02-11, D6)	650m (south-west)	Portland Formation	80m AOD	Feeds into a small stream/drain which appears to be disconnected from other surface water features.
Issues at Sheepcote Hill Farm (Map WR-02-11, D6)	955m (south-west)	Portland Formation	100m AOD	Feed into small streams/ditches at Eythrope.
Spring north-west of Upper Cranwell Farm (Map WR-02-11, C6)	800m (south-west)	Appears within Kimmeridge Clay Formation	104m AOD	Does not appear to be connected to any small streams/other surface water features.
Stream emerging north of Triangle Business Park (Map WR-02-11, C6)	770m (north-east)	Appears within Upper Greensand	105m AOD	Stream flows westwards towards the Bear Brook.

3.5 Water dependent habitats

3.5.1 Table 6 summarises existing water dependent habitats within 1km of the route. The table identifies where a water dependency exists. The assessment of the impact on water dependent ecology receptors is found Volume 2, CFA Report 11, Section 7.

Table 6: Description of water dependent habitats

Name/location[7]	Distance (m) and direction from route	Designation	Comments
Aylesbury Sewage Treatment Works Local Wildlife Site (LWS) (Map EC-01-024, F5)	90m north (upstream of route crossing)	LWS	The LWS contains pasture, open water and scrub and is designated for its variety of bird species.
River Thame Biological Notification Site (BNS) (Map EC-01-024, F5)	90m north (upstream of route crossing) (adjacent to the Aylesbury Sewage Treatment Works LWS).	BNS	The BNS is designated for its floodplain grassland and riparian habitat with uncommon plant species.

[7] Map references to Volume 5: Ecology Map Book

Name/location[7]	Distance (m) and direction from route	Designation	Comments
River Thame (Map EC-01-024, F6)	Will be crossed by the route	District/borough value	Good diversity of aquatic plant species.
Nine ponds (refer to Table 1 for details). (Map WR-01-014 and WR-01-015, Volume 5, Water Resources and Flood Risk Assessment Map Book)	Within 1km of route. One pond within Aylesbury Golf Course will be crossed by the route.	Local/parish value	Two ponds within Aylesbury Golf Course contain good plant and animal diversity.

4 Site specific surface water assessment

4.1 Summary of assessment

4.1.1 Table 7 summarises the potential impacts and effects, both significant and not significant, to surface water features from the Proposed Scheme in the area. Only those impacts and effects that are classed as significant are presented in Volume 2, CFA Report 11, Section 13.4.

4.1.2 Table 7 only includes water features which could potentially be affected by the Proposed Scheme. Features such as isolated ponds and drains which will lie outside the construction footprint and area of impact of the Proposed Scheme are not included. Details of all the features are provided in Table 1.

4.1.3 The draft Code of Construction Practice (CoCP), referred to in Table 7, sets out the measures and standards of work that will be applied to the construction of the Proposed Scheme (see Volume 5: Appendix CT-003-000/1). These will provide effective management and control of the impacts during the construction period.

Table 7: Summary of potential impacts to surface water

Surface water feature/ receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual Effect	Duration of effect
Water features									
Stoke Brook and tributaries SWC-CFA11-01 to SWC-CFA11-06 and SWC-CFA11-18	High	Permanent channel diversions and four crossings Balancing ponds and associated drainage	During works for the culverting and diversion of the watercourses. Construction of the balancing ponds and drainage will have the potential for temporary effects, for example, short-term increases in sediment loading and temporary impacts to flow. The crossings were identified as being medium risk surface water body crossings in the route-wide WFD Preliminary Screening Assessment.	Major impact Large effect (Significant)	Monitoring during and after construction The mitigation measures set out within the draft CoCP to control sediment mobilisation and risk of spills.	Negligible impact Neutral effect (Not significant)	None	Negligible impact Neutral effect (Not significant)	Construction (temporary)
Stoke Brook and tributaries SWC-CFA11-01 to SWC-CFA11-06 and SWC-CFA11-18	High	Balancing ponds and associated drainage	Permanent impact on flow regime in receiving watercourse. Deterioration in water quality from routine discharges from the railway and associated infrastructure or spills. The crossing was identified as being a medium risk surface water body crossing in the route-wide WFD Preliminary Screening Assessment. (See Section 4.2 of this report)	Negligible impact Neutral effect (Not significant)	Measures to be adopted in the design process Balancing pond before outfall to watercourse designed to meet the Environment Agency's discharge conditions	Negligible impact Neutral effect (Not significant)	None	Negligible impact Neutral effect (Not significant)	Construction (permanent)

Surface water feature/ receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual Effect	Duration of effect
Stoke Brook and unnamed field drain near Hall End SWC-CFA11-19,SWC-CFA11-20 and SWC-CFA11-21.	High	Stoke Mandeville bypass crossing and replacement culvert under mainline railway. Balancing ponds and associated drainage	During works for the culverting of the watercourses and construction of the balancing ponds and drainage, there is a potential for temporary effects during construction; for example, a short-term increase in sediment loading and temporary impacts to flow. The crossing was identified as being a medium risk surface water body crossing in the route-wide WFD Preliminary Screening Assessment.	Minor impact Moderate effect (significant)	Monitoring during and after construction The mitigation measures set out within the draft CoCP control sediment mobilisation and risk of spills.	Negligible impact Neutral effect (Not significant)	None	Negligible impact Neutral effect (Not significant)	Construction (temporary)
Stoke Brook and unnamed field drain near Hall End SWC-CFA11-19,SWC-CFA11-20 and SWC-CFA11-21.	High	Balancing ponds and associated drainage	Permanent impact on flow regime in receiving watercourse. Deterioration in water quality from routine discharges from the railway and associated infrastructure or spills.	Negligible impact Neutral effect (Not significant)	Balancing pond before outfall to watercourse designed to meet the Environment Agency's discharge conditions.	Negligible impact Neutral effect (Not significant)	None	Negligible impact Neutral effect (Not significant)	Construction (permanent)
Sedrup Ditch and tributary SWC-CFA11-07 & SWC-CFA11-08	Moderate	Sedrup north culvert (see Table 8 for details) Balancing	The watercourse is not a designated WFD water body. The existing alignment has been straightened. As field drains, it is likely that they are regularly	Minor impact Slight effect (Not significant)	The mitigation measures set out within the draft CoCP will control sediment mobilisation and the risk of spills.	Negligible impact Neutral effect (Not significant)	None	Negligible impact Neutral effect (Not	Construction (temporary)

Surface water feature/ receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual Effect	Duration of effect
		ponds and associated drainage	maintained. Potential sediment mobilisation during construction (See Section 4.2 of this report)					significant)	
Sedrup Ditch and tributary SWC-CFA11-07 & SWC-CFA11-08	Moderate	Balancing ponds and associated drainage	Permanent impact on flow regime in receiving watercourse. Deterioration in water quality from routine discharges from the railway and associated infrastructure or spills.	Negligible impact Neutral effect (Not significant)	Balancing pond before outfall to watercourse designed to meet the Environment Agency's discharge conditions	Negligible impact Neutral effect (Not significant)	None	Negligible impact Neutral effect (Not significant)	Construction (permanent)
Lower Hartwell Ditches SWC-CFA11-09 to SWC-CFA11-11	Moderate	Lower Hartwell No.1 and 2 culverts (see Table 8 for details) Balancing ponds and associated drainage	The watercourse is not a designated WFD water body. The existing alignment has been straightened. As field drains these are likely to be regularly maintained. Potential sediment mobilisation during construction but not more than during current drain maintenance. (See Section 4.2 of this report)	Minor impact Slight effect (Not significant)	The mitigation measures set out within the draft CoCP to control sediment mobilisation and risk of spills.	Negligible impact Neutral effect (Not significant)	None	Negligible impact Neutral effect (Not significant	Construction (temporary)
Lower Hartwell Ditches SWC-CFA11-09 to SWC-CFA11-11	Moderate	Lower Hartwell No.1 and 2 culverts Balancing ponds and associated	Permanent impact on flow regime in receiving watercourse. Deterioration in water quality from routine discharges from the railway and associated infrastructure or spills.	Negligible impact Neutral effect (Not significant)	Balancing pond before outfall to watercourse designed to meet the Environment Agency's discharge conditions	Negligible impact Neutral effect (Not significant)	None	Negligible impact Neutral effect (Not significant)	Construction (permanent)

Surface water feature/ receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual Effect	Duration of effect
		drainage							
River Thame and tributaries SWC-CFA11-12 to SWC-CFA11-14	High	Thame valley viaduct (see Table 8 for details) Balancing pond and associated drainage	Pier footings across the flood plain and the minor tributary. (See Section 4.2 of this report)	Minor impact Moderate effect (significant)	Pier of Thame valley viaduct previously on bank/within River Thame has now been relocated further north and removed from channel. There is therefore no requirement to divert water channel. The mitigation measures set out within the draft CoCP to control sediment mobilisation and risk of spills	Negligible impact Neutral effect (Not significant)	None	Negligible impact Neutral effect (Not significant)	Construction (temporary)
River Thame and tributaries SWC-CFA11-12 to SWC-CFA11-14	High	Balancing pond and associated drainage	Permanent impact on flow regime in receiving watercourse. Deterioration in water quality from routine discharges from the railway and associated infrastructure or spills.	Negligible impact Neutral effect (Not significant)	Balancing pond before outfall to watercourse designed to meet the Environment Agency's discharge conditions	Negligible impact Neutral effect (Not significant)	None	Negligible impact Neutral effect (Not significant)	Construction (permanent)
Tributary of Fleet Marston Brook (field drain from Coney Hill and Fleet Marston Spinney)and Drain from	Moderate	Culverts (see Table 8 for details)	The watercourse is not a designated WFD water body. The existing alignment has been straightened. As field drains these are likely to be regularly maintained. Potential sediment mobilisation during construction but not more	Minor impact Slight effect (Not significant)	As set out in the Cross drainage Deliverable approach statement The mitigation measures set out within the draft CoCP to control sediment mobilisation and risk of spills.	Negligible impact Neutral effect (Not significant)	None	None	Construction (temporary)

Surface water feature/ receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual Effect	Duration of effect
Upper Cranwell Farm (tributary of Fleet Marston Brook) SWC-CFA11-15 & SWC-CFA11-16			than during drain maintenance. (See Section 4.2 of this report)						
South Lower Hartwell Ditch and unnamed pond SWC-CFA11-28	Low	Balancing ponds and associated drainage	Potential deterioration of water quality due to deposition or spillage of soils, sediment, fuels or other construction materials; the mobilisation of contamination following disturbance of contaminated ground or groundwater and through uncontrolled site runoff.	Minor impact Neutral effect (Not significant)	Balancing pond before outfall to watercourse designed to meet the Environment Agency's discharge conditions	Minor impact Slight effect (Not significant)	None	Minor impact Slight effect (Not significant	Construction (permanent)
Unnamed drain south of Putlowes SWC-CFA11-14	Moderate	Balancing pond and associated drainage	Potential deterioration of water quality due to deposition or spillage of soils, sediment, fuels or other construction materials; the mobilisation of contamination following disturbance of contaminated ground or groundwater and through uncontrolled site runoff.	Minor impact Slight effect (Not significant)	Balancing pond before outfall to watercourse designed to meet the Environment Agency's discharge conditions	Minor impact Slight effect (Not significant)	None	Minor impact Slight effect (Not significant)	Construction (permanent)
Unnamed drain from Coney Hill and Fleet	Moderate	Balancing ponds	Permanent impact on flow regime in receiving watercourse. Deterioration in water quality from routine discharges from the	Minor impact Slight effect	The mitigation measures set out within the draft CoCP to control sediment mobilisation	Minor impact Slight effect	None	Minor impact Slight effect	Construction (permanent)

Surface water feature/ receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual Effect	Duration of effect
Marston Spinney SWC-CFA11-15 and SWC-CFA11-35			railway and associated infrastructure or spills.	(Not significant)	and risk of spills. Balancing pond before outfall to watercourse designed to meet the Environment Agency's discharge conditions	(Not significant)		(Not significant)	
Unnamed drain from Upper Cranwell Farm SWC-CFA11-16 and SWC-CFA11-36	Moderate	Balancing pond	Potential deterioration of water quality due to deposition or spillage of soils, sediment, fuels or other construction materials; the mobilisation of contamination following disturbance of contaminated ground or groundwater and through uncontrolled site runoff.	Minor impact Slight effect (Not significant)	The mitigation measures set out within the draft CoCP to control sediment mobilisation and risk of spills. Balancing pond before outfall to watercourse designed to meet the Environment Agency's discharge conditions	Minor impact Slight effect (Not significant)	None	Minor impact Slight effect (Not significant)	Construction (temporary)
Two unnamed ponds SWC-CFA11-32	Low	Earthworks and boundary fencing Within construction boundary.	Loss of ponds - will require infilling.	Moderate impact Minor effect (Not significant)	Eight ponds and with a terrestrial habitat to be created east of the Aylesbury South as ecological mitigation. Refer to Ecology Volume 2, CFA Report 11, Section 7 for details.	Negligible water resources Neutral effect (Not significant)	None	Neutral effect	Construction (Permanent)

4.2 Detailed assessments

Assessment of potential impacts of surface water crossings

4.2.1 The locations and descriptions of the surface water crossing in the Stoke Mandeville and Aylesbury area are given in Table 8.

Table 8: Proposals for surface water crossings

Water feature	Crossing	Description	Length of culvert* (m)	WFD water body, designation and status
Chalkshire Stream	SWC-CFA11-01	Diversion (approximately 150m) along west side of Stoke Mandeville south embankment at Nash Lee Orchard public footpath with outfall to Stoke Brook.	60	No status class shown in RBMP– assumed status Moderate
Stoke Brook	SWC-CFA11-18	Culvert beneath the embankment for the footpath ELL/20 overbridge.	40	Stoke Brook (Aylesbury), (GB106039030320) Moderate
Stoke Brook	SWC-CFA11-02	Culvert crossing Stoke Mandeville south embankment at Nash Lee orchard.	47	Stoke Brook (Aylesbury), (GB106039030320) Moderate
Stoke Brook	SWC-CFA11-03	Culvert crossing Stoke Mandeville south embankment near the site of St Mary's Church.	58	Stoke Brook (Aylesbury), (GB106039030320) Moderate
Tributary of Stoke Brook	SWC-CFA11-04 – diversion so no longer crossed at this point	Bypassed by diversion (see SWC-CFA11-06)	76	No status class shown in RBMP– assumed status Moderate
Tributary of Stoke Brook	SWC-CFA11-05 – diversion so no longer crossed at this point	Bypassed by diversion (see SWC-CFA11-06)	92	No status class shown in RBMP– assumed status Moderate
Tributary of Stoke Brook	SWC-CFA11-06	Diversion (approximately 340m) along west side of Stoke Mandeville south embankment to culvert beneath embankment followed by 50-60m new channel with outfall to original course of Stoke Brook south of Stoke House.	77	No status class shown in RBMP– assumed status Moderate
Stoke Brook	SWC-CFA11-19	Slight realignment of channel immediately upstream and culvert across Stoke Brook.	60	Stoke Brook (Aylesbury), (GB106039030320) Moderate
Unnamed drain near Hall End	SWC-CFA11-20	Culvert across the unnamed and isolated drain.	40	No status class shown in RBMP– assumed status. Moderate
Tributary of Sedrup	SWC-CFA11-07	Culvert across Aylesbury embankment including acoustic	187	No status class shown in

Water feature	Crossing	Description	Length of culvert* (m)	WFD water body, designation and status
Ditch		mitigation earthworks.		RBMP– assumed status Moderate
Sedrup Ditch	SWC-CFA11-08	Culvert across Aylesbury embankment including acoustic mitigation earthworks with 200m of new channel downstream.	150	No status class shown in RBMP– assumed status Moderate
Hartwell Ditch	SWC-CFA11-09	Two culverts and three short sections of diversion channel (approximately 50m, 35m and 125m). One culvert will pass beneath the Footpath SBH/32 overbridge and a second culvert will pass beneath the Oxford Road embankment.	43 and 33	No status class shown in RBMP– assumed status Moderate
Lower Hartwell Ditch	SWC-CFA11-10	Culvert beneath the Oxford Road embankment.	30	No status class shown in RBMP– assumed status Moderate
Drain north of Lower Hartwell Ditch	SWC-CFA11-11	New balancing pond and, culvert beneath Oxford Road embankment.	30	No status class shown in RBMP– assumed status Moderate
Tributary of River Thame south of Bear Brook	SWC-CFA11-12	Viaduct	Not applicable	No status class shown in RBMP– assumed status Poor
River Thame	SWC-CFA11-13	Viaduct	Not applicable	Thame (Aylesbury to Scotsgrove Brook) (GB106039030370) Poor
Unnamed drain south of Putlowes	SWC-CFA11-14	Existing culvert and slght realignment of drain.	Not applicable	No status class shown in RBMP– assumed status. Poor
Tributary of Fleet Marston Brook (field drain from Coney Hill and Fleet Marston Spinney)	SWC-CFA11-15	Changed alignment to join drain from Upper Cranwell Farm upstream rather than downstream of the route to minimise culverting. The diversion is approximately 300m long.	Not applicable	No status class shown in RBMP– assumed status Poor
Drain from Upper Cranwell Farm (tributary of Fleet Marston Brook)	SWC-CFA11-16	Culvert beneath the Bicester Road embankment	50	No status class shown in RBMP– assumed status. Poor

* The length is based on the consolidated construction boundary. The actual length of the culvert is to be confirmed and will be subject to agreement with the Environment Agency.

4.2.2 The crossings listed in Table 8 are locations where potential temporary or permanent impacts from construction have been identified. The approach will therefore be to minimise the impact on water quality, flow and drainage and thus minimise the impact on the ecology of the water features as well. The impacts on ecological receptors are addressed in the Ecology section, Volume 2, CFA Report 11, Section 7.

4.2.3 Construction of crossings will follow best practice as set out in the draft CoCP.

4.2.4 Two generic forms of construction will be considered if the culvert is on the line of the existing watercourse:

- construct a temporary watercourse diversion adjacent to the watercourse, build the new culvert, and then divert the watercourse through the new culvert; or
- by-pass the construction area by pumping water over the length required to build the online culvert.

4.2.5 The choice between which option to select will be taken on a location by location basis taking into account safety of the workforce, the volume of water, availability of land for the diversion, views of the Environment Agency and the programmed period to undertake the work.

4.2.6 Generally the Environment Agency will be consulted on the design of the culverts and diversion proposals and any other mitigation measures. Such other mitigation measures will include:

- avoiding culverts where possible and maintaining an open watercourse;
- minimising the culvert lengths as far as reasonably practicable, even if this requires some realignment of the upstream approach reach;
- maintaining the natural bed profile within the channel, both in terms of channel gradients and substrates;
- maintaining natural flow depths, widths and velocities, (including natural variance and diversity) at the culvert inlet and outlet;
- constructing diversions and realigned channel sections in advance to allow stabilisation and vegetation growth, to minimise sediment mobilisation when the flow is first diverted; and
- other measures, to be agreed with the Environment Agency, to ensure that the culverts are environmentally sympathetic to minimise their impacts on natural processes and biodiversity as far as reasonably practicable.

Potential impacts of alteration to the Stoke Brook and its tributaries south of Stoke Mandeville

4.2.7 The Stoke Brook and its tributaries will be crossed by the route at SWC-CFA11-01 to SWC-CFA11-06. The crossings will include multiple diversions and realignment of the brook and its tributaries as detailed in Table 8 and shown in Figure 2 and Figure 3.

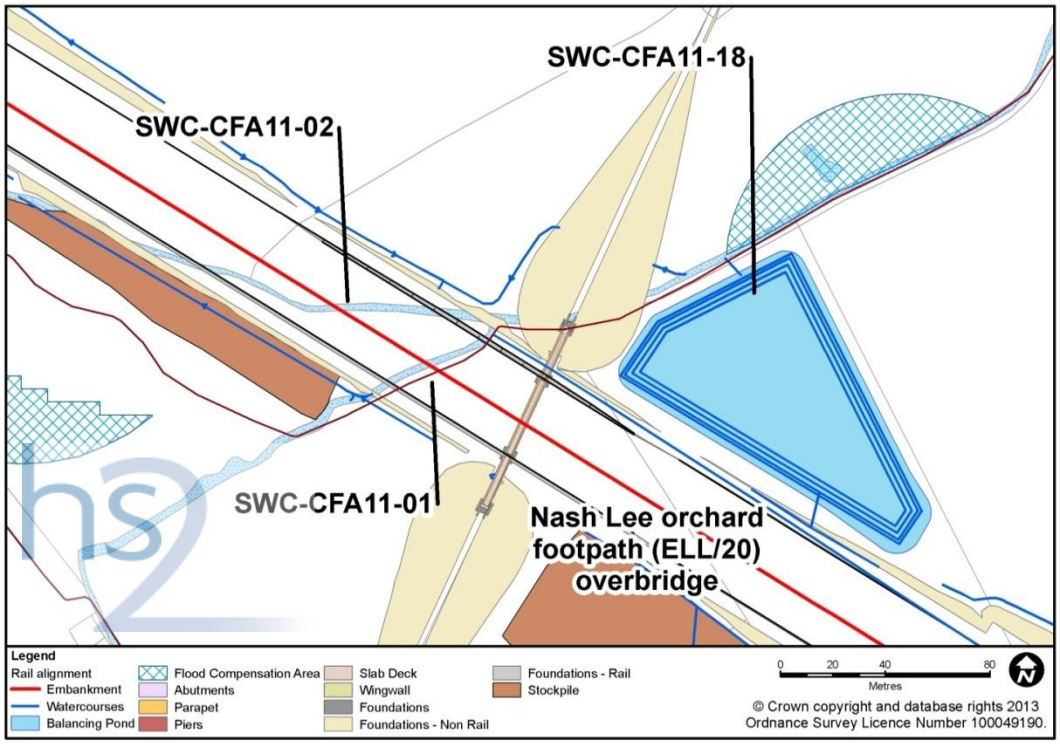
4.2.8 The course of the Stoke Brook has been significantly modified in the past in the area to the south of Stoke Mandeville to divert flow towards the grounds of Stoke House where a lake has been created. The original channel in the valley bottom was maintained to provide water to a mill downstream. The bifurcation lies between the route crossing points at SWC-CFA11-02 and SWC-CFA11-03. The two branches re-join just upstream of the Risborough Road.

4.2.9 The Environment Agency has classified the Stoke Brook under the WFD, although the stretch that is classified in the RBMP is the branch of the watercourse passing through the grounds of Stoke House and not the original channel. For the purposes of the assessment of the Proposed Scheme both channels are assumed to have the same WFD objectives.

4.2.10 Upstream of the Risborough Road the Stoke Brook and its tributaries will be conveyed beneath the Proposed Scheme through a number of culverts. There will be a substantial amount of embankment constructed in the vicinity of the watercourse.

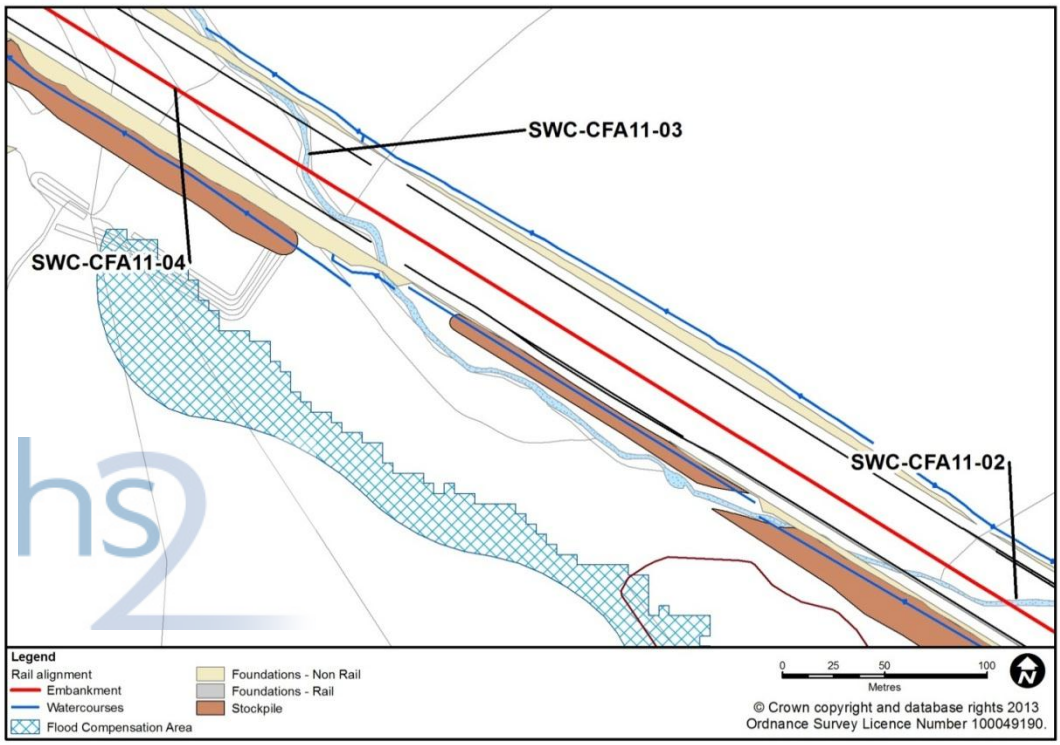
4.2.11 The main channel will be culverted (SWC-CFA11-18) beneath the earthworks for the Footpath ELL/20 overbridge. The main channel of the Stoke Brook will then be diverted through the Stoke Mandeville south embankment in culvert (SWC-CFA11-02) to combine with the Chalkshire Stream on the western side of the route. It will then be diverted alongside the route for approximately 150m before re-joining the existing channel (see Figure 2).

Figure 2: Proposed crossings of the Stoke Brook at CFA10/CFA11 boundary (SWC-CFA11-01, SWC-CFA11-02 and SWC-CFA11-18)



4.2.12 The main channel of the Stoke Brook will be retained in its existing alignment passing back under the embankment in culvert (see Figure 3) before continuing to Stoke House.

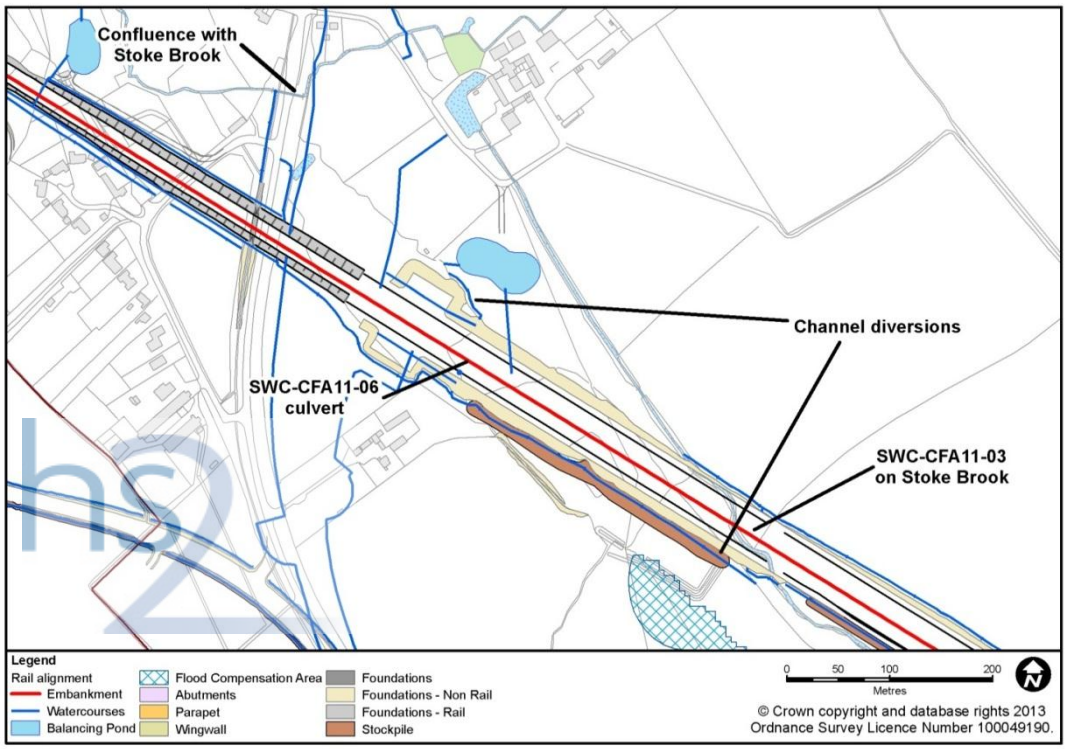
Figure 3: Watercourse crossing proposals (SWC-CFA11-02, SWC-CFA11-03 and SWC-CFA11-04)



4.2.13 The bifurcation upstream of SWC-CFA11-03 will continue to provide water to the tributary flowing in the valley bottom towards Mill House Farm and the Risborough

Road. As shown in Figure 4 this channel will be realigned to run along the west side of the embankment losing its meandering channel form. The realigned channel will cross beneath the embankment to re-join the Stoke Brook at SWC-CFA11-06.

Figure 4: Watercourse crossing proposals (SWC-CFA11-03, SWC-CFA11-04, SWC-CFA11-05 and SWC-CFA11-06)



4.2.14 The existing watercourses and flood plains will experience major impacts from the construction works in this small area. The valley is quite narrow and the Stoke Mandeville embankment will occupy a significant part of it.

4.2.15 Flood replacement storage will be provided on the west side of the embankment to account for the impact on flooding (refer to Volume 5; Appendix WR-003-011 for details) and avoid a significant effect on flood risk.

4.2.16 The diversions will be designed (as described above) to ensure that the existing flow and water quality regimes are maintained and are acceptable to the Environment Agency. The new channels will be of similar length to the existing alignments. Where practicable the new channel sections will be constructed in advance and will be allowed to stabilise and vegetation established to control the risk of sediment mobilisation when the stream is actually diverted into the new channel sections. The sequencing of construction activities for channel diversions will be developed and agreed with the Environment Agency as part of the method statement prepared prior to construction.

4.2.17 Given the need for work in the channel in the approach sections to crossings, mitigation will be incorporated to avoid major impacts during construction due to a temporary decrease in water quality. All such work will be carried out in accordance with the draft CoCP (Section 16). Method statements will be produced that draw on

the Environment Agency's Guidelines for Works and maintenance in or near water (PPG5)[8] as described in Section 16 of the draft CoCP. Appropriate mitigation could include the use of physical barriers such as bunds, booms or silt curtains and temporal considerations such as working at times of low flow or in drier conditions.

4.2.18 As a result, it is anticipated that the water quality will depart from normal baseline values for short periods towards levels typically achieved during flood events or normal channel maintenance.

4.2.19 In accordance with Section 16 of the draft CoCP monitoring of the Stoke Brook channels will be undertaken to confirm that the CoCP measures are adequate and that no further measures are required to control the temporary impact of sediment mobilisation. This will reduce the magnitude of impact to negligible.

4.2.20 Implementation of the draft CoCP allows the temporary construction effects to be assessed to be neutral and no further mitigation will be required.

4.2.21 As all new watercourse channels will be designed to ensure flow dynamics are similar to the existing channels, the permanent effects on the flow and water quality regime in both the Stoke Brook main channel and the smaller tributary channel will not be significant.

4.2.22 The impact on hydromorphology has been assessed to be negligible for the Stoke Brook main channel (which is itself artificial for part of its length in this local area) but major for the small tributary. The design of the diversion channel lengths for the latter will incorporate new meanders where practicable and this will be done in consultation with the Environment Agency. Therefore after the new channels have stabilised it is assessed that the permanent impact on the hydromorphology of the tributary will be negligible, resulting in a neutral effect.

4.2.23 Overall for the Stoke Brook in this small area it is assessed that the permanent effects of construction of the Proposed Scheme will not be significant.

4.2.24 Appropriate mitigation measures to minimise the effects on ecological receptors are discussed in the Volume 2, CFA Report 11, Section 7. This will include an area of environmental mitigation as shown on Map CT-06-040 (Volume 2, CFA11 Map Book).

Potential impacts of a viaduct on the River Thame and tributaries west of Aylesbury

4.2.25 The route will cross the River Thame and tributaries on a viaduct to the west of Aylesbury at SWC-CFA11-12, SWC-CFA11-13 and SWC-CFA11-14 (the latter in an existing culvert). At the proposed crossing the River Thame has a catchment size of approximately 216km^2.

4.2.26 The viaduct crossing is shown on Map CT-06-045 (Volume 2, CFA11 Map Book) and will span the main channel of the River Thame and the full width of the flood plain including the left bank tributary/backwater. Design developments have allowed pier

[8] Environment Agency, Environment and Heritage Service for Northern Ireland and the Scottish Environment Protection Agency (2007) Pollution Prevention Guidelines, Works and maintenance in or near water: PPG5

footings to be located outside the normal channel of the River Thame thus reducing the potential for impact substantially.

4.2.27 It is assumed that two pier footings will be located within the channel at SWC-CFA11-12 (Map CT-06-045, E6). This tributary is noted to be a channel entirely within the flood plain of the River Thame and is believed to be part of a sustainable drainage system (SuDS) for other development that has taken place in the area. Micro siting of piers will be undertaken during detailed design but only a short channel realignment will be required at SWC-CFA11-12 to avoid any temporary or permanent impacts on flow and water quality during construction. Any loss of flood storage will be compensated to ensure the flood management function is not compromised.

4.2.28 The footings for one pier for the viaduct at SWC-CFA11-14 will potentially be located within or adjacent to the existing culvert of a tributary of the Fleet Marston Brook which rises west of Putlowes Farm. The pier footings will be designed to avoid any impact on the integrity of the existing culvert. The footings will not, therefore, impede normal levels of flow or effect sediment regimes. There should be no impact as a result of construction.

4.2.29 In accordance with Section 16 of the draft CoCP monitoring of the River Thame channel will be undertaken to confirm that the CoCP measures are adequate and that the temporary impacts are negligible. If adverse effects were identified immediate on site measures to halt the cause of the water quality deterioration would be implemented (e.g. putting additional surface runoff controls in place).

4.2.30 Implementation of the draft CoCP means the temporary construction effects are assessed to be neutral and no further mitigation will be required.

4.2.31 The impact on hydromorphology has been assessed to be negligible for the River Thame channel and flood plain due to the relatively small footprint of the viaduct piers compared to the size of the river. It is therefore assessed that the permanent construction impacts on hydromorphology will be negligible.

4.2.32 Overall for the River Thame and the minor tributary on the south bank it is assessed that the permanent impacts of construction of the Proposed Scheme will be negligible resulting in a neutral effect.

Highway drainage assessment

4.2.33 Realignment of two minor roads (Old Risborough Road and Marsh Lane) and one major roads (A418 Oxford Road), plus the construction of a new Stoke Mandeville bypass road, are required as part of the Proposed Scheme in this area.

4.2.34 The Scope and methodology report (SMR) (see Volume 5: Appendix CT-001-000/1) and the SMR Addendum (see Volume 5: Appendix CT-001-000/2) state that a Design Manual for Roads and Bridges[9] (DMRB) (Department for Transport, 2013) Highways Agency Water Risk Assessment Tool (HAWRAT) assessment is required for realigned roads forecast to exceed both an average annual daily traffic (AADT) value of 10,000

[9] Department for Transport, (2013). Design Manual for Roads and Bridges: http://www.dft.gov.uk/ha/standards/dmrb/vol11/section3/hd4509.pdf

and a heavy goods vehicles (HGV) value of 500. An initial desk study assessment has been carried out which will be further refined at the detailed design stage for the road realignments and the new bypass.

4.2.35 The following assumptions were made in order to carry out this initial assessment:

- the impermeable road area drained was estimated from satellite imagery and ordnance survey (OS) maps or the design proposals;
- the base flow index of the receiving watercourse has been taken as the HAWRAT default of 0.5; and
- for the minor watercourses a conservative river width of 1m was estimated from satellite imagery.

A418 Oxford Road

4.2.36 The A418 Oxford Road is forecast to experience AADT of HGV of greater than 500 and an overall AADT of greater than 10,000. The HAWRAT assessment was undertaken for the Oxford Road- A418, discharging to a local drain which feeds the Stoke Brook. The Oxford Road-A418 fails Step 1 for both pollutants copper and zinc, and for sediment.

4.2.37 The Oxford Road-A418 passes the assessment on all accounts at Step 2. Therefore, no adverse impact on water quality is foreseen and no mitigation is required.

Stoke Mandeville bypass

4.2.38 The Stoke Mandeville bypass is forecast to experience AADT of HGV of greater than 500 and an overall AADT of greater than 10,000. The HAWRAT assessment was undertaken for the Stoke Mandeville bypass, discharging to the Stoke Brook. The Stoke Mandeville bypass fails Step 1 for both pollutants copper and zinc, and for sediment.

4.2.39 The Stoke Mandeville bypass passes Step 2 for both pollutants copper and zinc, but fails for sediment so mitigation measures will be required.

4.2.40 Step 3 allows an assessment of the effects of (i) restriction on the maximum outfall discharge rate to attenuate road runoff, (ii) treatment of road runoff to reduce pollutant concentrations and (iii) settlement of sediments in the road runoff to reduce annual sediment volume. Nominal mitigation values of 50% treatment have been assumed in this assessment. This nominal mitigation value is sufficient to bring the water quality within permissible limits and induce negligible impact on the water environment.

4.2.41 Appropriate mitigation will be provided to address the risks to the receiving watercourse (for both flow and water quality) and will be selected using the DMRB (particularly HA103/06) and Construction Industry Research and Information Association (CIRIA) guidance[10]. The mitigation measures will be finalised at the detailed design stage. Remaining impacts will be negligible and the effect neutral as a result.

[10] Murname, E., Heap, A. and Swain, A., 2006, C648 Control of Water Pollution from Linear Construction Sites, CIRIA, London, UK.

5 Site specific groundwater assessment

5.1 Summary of assessment

5.1.1 Table 9 summarises the potential impacts to hydrogeology (groundwater), abstractions, water dependent habitats and surface water/groundwater interactions. Only those impacts and effects that are classed as significant are presented in Volume 2, CFA Report 11, Section 13.4.

Table 9: Summary of potential impacts to groundwater, abstractions, water dependent habitats and surface water/groundwater interactions

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Mitigation measures included in design	Magnitude of remaining impact and significance of effect	Further mitigation	Residual effect	Duration of effect
Hydrogeology (groundwater)									
Portland Stone and Portland Sand Formations Lower Greensand Group Purbeck Group (Primary and Secondary A aquifers)	Moderate High (Portland Stone Formation)	Aylesbury embankment Oxford Road embankment	The embankments will not intercept groundwater. There could be an impact on local groundwater quality during construction.	Minor impact Slight effect (Not significant)	With implementation of the draft CoCP, shallow groundwater quality is unlikely to be significantly impacted by construction.	Negligible impact Neutral effect (Not significant)	None	None	Construction (temporary) and construction (permanent)
Portland Stone Formation (Principal aquifer) Portland Sand Formation (Secondary A aquifer) Purbeck Group (Secondary undifferentiated aquifer)	Moderate High (Portland Stone Formation)	Aylesbury north cutting	Whilst the hydrogeological regime may change in the immediate vicinity of the cutting, the overall regime within the aquifers will not be significantly affected. There could be an impact on local groundwater quality during construction.	Minor impact Slight effect (Not significant)	With implementation of the draft CoCP, groundwater quality is unlikely to be significantly impacted by construction in this area.	Minor impact Slight effect (Not significant)	None	None	Construction (temporary) and construction (permanent)

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Mitigation measures included in design	Magnitude of remaining impact and significance of effect	Further mitigation	Residual effect	Duration of effect
Portland Sand Formation (Secondary A aquifer)	Moderate	Stockpile adjacent to A418	There is one stockpile in this study area that partially overlies the Portland Sand Formation aquifer, all others overlie unproductive strata. There is potential for constituents arising from the excavated stockpiled material to reduce the quality of groundwater in the Portland Sand Formation. See Section 5.2 of this report for further discussion	Moderate impact Moderate effect (Significant)	Suitable quality criteria will be defined prior to material being placed. The draft CoCP sets out the requirements about managing runoff from construction areas. This will reduce impacts on groundwater quality from runoff. Monitoring water quality will also be implemented as outlined in the draft CoCP Section 16	Negligible impact Neutral effect (Not significant)	Not required	None	Construction (Permanent)
Kimmeridge Clay Formation Ampthill Clay Formation (Unproductive strata)	Low	Oxford Road embankment Whaddon Hill cutting Thame valley south	These design elements will penetrate unproductive strata. As such, there will be a negligible impact to groundwater.	Negligible impact Neutral effect (Not significant)	Not required	Negligible impact Neutral effect (Not significant)	None	None	Construction (permanent)

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Mitigation measures included in design	Magnitude of remaining impact and significance of effect	Further mitigation	Residual effect	Duration of effect
		embankment Thame valley viaduct Thame valley north embankment Putlowes cutting Bicester Road embankment							
Abstractions									
Private licensed abstractions: GWA17 GWA18	High	Oxford Road embankment Thame valley south embankment	It is assumed that these wells abstract from superficial deposits and underlying Portland Formation. The route is on embankment (at Oxford Road and Thame valley south) and will not affect groundwater in the area close to GWA17 and GWA18. However, there could be an impact on groundwater quality during construction.	Minor impact Slight effect (Not significant)	With implementation of the draft CoCP, shallow groundwater quality is unlikely to be significantly impacted by construction in this area.	Negligible impact Neutral effect (Not significant)	None	None	Construction (temporary) and construction (permanent)

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Mitigation measures included in design	Magnitude of remaining impact and significance of effect	Further mitigation	Residual effect	Duration of effect
Surface water/groundwater interaction									
Springs near Sedrup	High	Aylesbury north cutting	The springs are related to groundwater in the Portland Formation. In general, groundwater flow is considered to be to the east and south-east from higher ground in the west and north-west. As such, it is unlikely that the springs in Sedrup will be significantly affected. See Section 5.2 of this report for further details.	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	None	None	Construction (temporary) and construction (permanent)
Springs near Hartwell House, Upper and Lower Hartwell	High	Aylesbury north cutting	A number of minor springs in the area to the south and west of Hartwell House flow into the lake at Hartwell House and into small streams that feed the Stoke Brook to the North of Hartwell House. Groundwater flow to these springs is expected to be from the Portland Formation. The lake and streams are located on the Kimmeridge Clay and are not in direct connectivity with any underlying	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	None	None	Construction (temporary)

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Mitigation measures included in design	Magnitude of remaining impact and significance of effect	Further mitigation	Residual effect	Duration of effect
			groundwater. The springs are outside of the zone of influence of the works associated with the Proposed Scheme. See Section 5.2 of this report for further details						
Hartwell House lake and Stoke Brook	High	Aylesbury north cutting	The springs at Hartwell House and Upper/Lower Hartwell feed into the lake at Hartwell House and the Stoke Brook. The springs are outside the zone of influence of the cutting and the natural direction of groundwater flow indicates that these will not be significantly disturbed. As such, flow to the lake and Stoke Brook are unlikely to be significantly affected. See Section 5.2 of this report for further details	Negligible impact Neutral effect (Not significant)	Any groundwater intercepted by the cutting will pass into the drainage system running parallel to the west of the route, discharging into existing ditches and watercourses, including the stream flowing from Hartwell Lake.	Negligible impact Neutral effect (Not significant)	None	None	Construction (temporary)

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Mitigation measures included in design	Magnitude of remaining impact and significance of effect	Further mitigation	Residual effect	Duration of effect
Water dependent habitats									
Aylesbury Sewage Treatment Works LWS	High	Thame valley viaduct	The LWS contains open water, although it will not be crossed by the route. Further to this, the route will be above ground in the vicinity of the LWS and will not significantly disturb groundwater flow or the surface water feature.	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	None	None	Not applicable
River Thame BNS	High	Thame valley viaduct	The BNS is on a floodplain, and it will not be crossed by the route directly. Further to this, the route will be above ground in the vicinity of the LWS and will not significantly disturb groundwater flow or the surface water feature.	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	None	None	Not applicable
Number of ponds (refer to Table 1 for details).	Low	Oxford Road embankment Whaddon Hill cutting Thame valley viaduct, cuttings and embankments	The majority of the ponds are isolated and will lie outside the area of land required for construction of the Proposed Scheme. They are not considered to be dependent on groundwater. They will therefore, not be affected by the Proposed	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	None	None	Not applicable

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Mitigation measures included in design	Magnitude of remaining impact and significance of effect	Further mitigation	Residual effect	Duration of effect
			Scheme.						
Two ponds within Aylesbury Golf Course	Low	Thame valley viaduct cutting	Two ponds within the Aylesbury Golf Course will be within the area of land required for construction of the Proposed Scheme and will therefore be lost.	Moderate impact Minor effect (Not significant)	Eight ponds and a terrestrial habitat to be created. Refer to Volume 2, CFA Report 11, Section 7.	Negligible impact neutral effect (Not significant)	None	Negligible impact neutral effect (Not significant)	Construction (permanent)

5.2 Detailed assessments

Impacts of cuttings on groundwater

Aylesbury south cutting

5.2.1 Cutting details are provided in Table 10.

Table 10: Summary of Aylesbury south cutting detailed groundwater assessment

Cutting parameters	Parameter details
Length (km)	2.35
Maximum depth (m)	6.7
Strata intercepted	Head deposits (Secondary undifferentiated aquifer), for 900m along route. Gault and Upper Greensand Formations (Unproductive strata)
Lowest track level (m AOD)	83.2
Groundwater level(s) (m AOD)	No groundwater present.
Principal receptors	No groundwater present.

5.2.2 The cutting will penetrate the Gault and Upper Greensand Formations. In this area these are considered to be unproductive strata as there is no evidence of any springs or issues in the vicinity of the route. To the south of the CFA11 boundary (in CFA10) there are a number of springs near the boundary between the Upper Greensand and Chalk (in the escarpment area known as The Three Hundreds of Aylesbury). Once the topography levels off near Stoke Mandeville there are no springs or issues near the route. It is therefore reasonable to assume that within the study area these formations will not contain significant groundwater.

5.2.3 There are two issues to the west of the route near Standalls Farm that rise between 89m AOD and 82m AOD. These rise on an outcrop of Gault Clay which is designated as unproductive strata, and therefore there is not likely to be any significant area supplying these issues. As these are located between 500m and 820m from the route it is highly unlikely the Proposed Scheme will have any impact on these issues, and therefore the potential effect is assessed as negligible and not significant.

5.2.4 Superficial deposits comprising Head are present over a length of approximately 900m of the cutting. The Head deposits are Secondary aquifers but unlikely to contain substantial volumes of water as they are limited in extent at this cutting. They are also not in connectivity with surface water features, and there are no abstractions within this stratum. Any disruption to local perched water tables will not significantly affect groundwater resources or surface water features.

5.2.5 In summary, the low permeability and designation of the strata as unproductive, indicates that there will be no impact to groundwater resources. There will also be no impact to surface water/groundwater interactions, the WFD status or groundwater dependent habitats.

Aylesbury north cutting

5.2.6 Cutting details are provided in Table 11.

Table 11: Summary of Aylesbury north cutting detailed groundwater assessment

Cutting parameters	Parameter details
Length (km)	0.65
Maximum depth (m)	5.4
Strata intercepted	No superficial deposits Portland Sand Member (Secondary A aquifer) Portland Stone Member, only partially cut (Principal aquifer)
Lowest track level (m AOD)	80.9
Groundwater level(s) (m AOD)	Unknown
Principal receptors	Springs to the south and west of Hartwell House/lake at Hartwell House. Springs that contribute to a stream that feeds Stoke Brook/Bear Brook at Aylesbury. Groundwater abstraction GWA17 (Upper Hartwell).

5.2.7 The cutting will penetrate the Portland Sand Member and will pass through the geological boundary between the Portland Sand and overlying Portland Stone Member. There is expected to be hydraulic connectivity between the Portland Stone and Portland Sand, which together comprise the Portland Formation. The Portland Formation is a thin formation in this area and is considered to be only about 3m to 5m thick in this area. It is underlain by the Kimmeridge Clay, which is unproductive and contains no significant groundwater.

5.2.8 There are no groundwater elevation data for aquifers within the vicinity of the cutting. The elevation of the water table has been inferred from the topographic elevations, estimated from 1:25 000 scale Ordnance Survey mapping, at which groundwater springs or issues occur, as follows:

- 83m AOD and 84m AOD at two spring sources south-west of the cutting at Sedrup;
- 90m AOD at a spring source just north of Sedrup;
- 90m AOD at the spring source known as Egyptian Well to the west of Hartwell House;
- 87m AOD at a spring source just north of Upper Hartwell; and
- 78m AOD at issues at Lower Hartwell.

5.2.9 The elevation of groundwater springs indicates that the water table is likely to be within 5m of the ground surface (i.e. above the inferred base of the Portland Formation) at the cutting.

5.2.10 The three springs in the vicinity of Sedrup contribute to small streams that flow to the south and east, eventually discharging to the Stoke Brook. The springs are located on the Portland Formation and are assumed to be fed by groundwater from either the Portland Stone or the Portland Sand. In general, groundwater flow is likely to be to the east and south-east, from higher ground in the west and north-west. As such, it is unlikely that the springs in Sedrup will be significantly affected by the Aylesbury North cutting, as the cutting is down gradient of the springs.

5.2.11 A number of minor springs in the area to the south and west of Hartwell House flow into the lake at Hartwell House and into small streams that feed the Stoke Brook to the north of Hartwell House. Groundwater flow to these springs is expected to be from Portland Formation which is to the south of the boundary with the Kimmeridge Clay. The lake and streams are present above Kimmeridge Clay and are not in direct connectivity with any underlying groundwater. Therefore any impact on the groundwater in the Portland Formation is not likely to affect the levels in the lake or streams directly. There could however be an impact if the spring flows which contribute flow to the lakes and streams have groundwater diverted from them.

5.2.12 Sichardt's equation has been used to assess the zone of influence on groundwater around the cutting, following guidance in CIRIA C515 (2000), Groundwater control – design and practice[11] and CIRIA C113 (1986) Control of groundwater for temporary works[12]. Sichardt's equation is presented below:

$$L_o = C \times h \times \sqrt{k}$$

Where: L_o = distance of influence from a linear structure (m)

k = hydraulic conductivity (m/s)

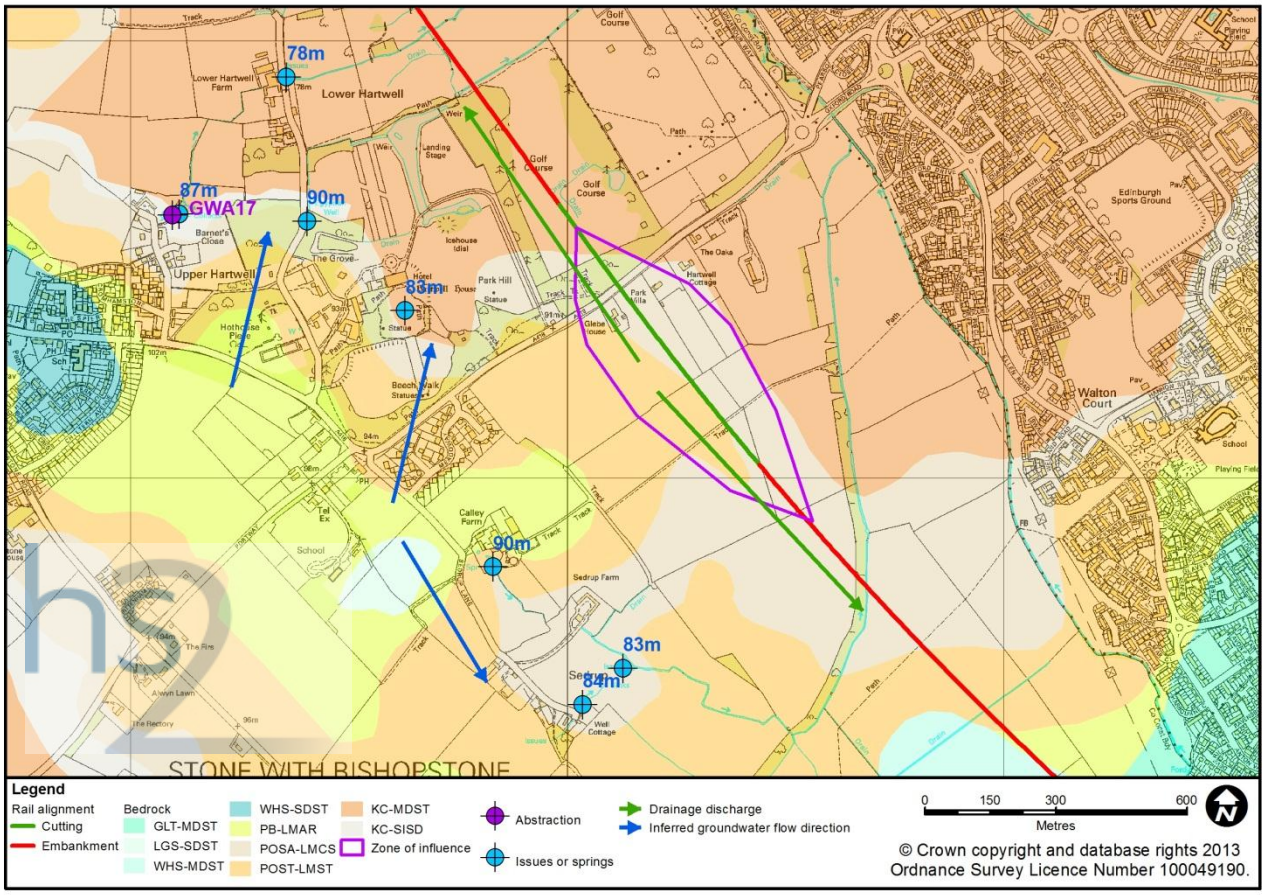
h = drawdown (m)

C = an empirical factor, taken to be 2,000

5.2.13 Using a maximum drawdown (*h*) of 5m (assumed thickness of the Portland Formation) and a hydraulic conductivity of 0.000174m/s (BGS, 1997)[13], the maximum extent of the zone from the cutting is 132m from the route. Figure 5 shows the zone of influence in relation to the springs. The figure demonstrates that any groundwater flow affected by the cutting will not significantly disturb flow towards the springs identified. This includes the springs in the vicinity of Sedrup, as well as the springs around Hartwell House which feed Hartwell House lake. As a result neither the springs nor flows into the lake will be affected. In addition any discharges from the lake which feed into the Stoke Brook further downstream will be unaffected.

[11] CIRIA (2000) CIRIA C515 Groundwater control – design and practice
[12] CIRIA (1986) CIRIA C113 Control of groundwater for temporary works
[13] BGS (1997) *The aquifer properties of major aquifers in England and Wales.* Hydrogeology Group Technical Report WD/97/34, Environment Agency R&D Publication 8

Figure 5: Zone of influence of the Aylesbury north cutting[14]



5.2.14 Any groundwater intercepted by the cutting will pass into the drainage system running parallel to the route. The drainage system will discharge into existing ditches and watercourses which feed the Stoke Brook further downstream. The discharge from the drainage system will compensate for any losses to the Stoke Brook resulting from the interception of groundwater in the cutting.

5.2.15 In conclusion, there will be no significant effects to groundwater flow, GWA17, the lake at Hartwell House, spring flows and the contribution to small streams feeding the Stoke Brook.

[14] Key to geology legend: GLT-MDST = Gault Formation, LGS-SDST = Lower Greensand Group, WHS-MDST = Whitchurch Sand Formation (mudstone), WHS-SDST = Whitchurch Sand Formation (sandstone), PB-LMAR = Purbeck Group, POSA-LMCS = Portland Sand Formation, POST-LST = Portland Stone Formation, KC-MDST = Kimmeridge Clay Formation (mudstone) and KC-SISD = Kimmeridge Cay Formation.

Whaddon Hill cutting

5.2.16 Cutting details are provided in Table 12.

Table 12: Summary of Whaddon Hill cutting detailed groundwater assessment

Cutting parameters	Parameter details
Length (km)	0.95
Maximum depth (m)	5.6
Strata intercepted	No superficial deposits Kimmeridge Clay (Unproductive strata)
Lowest track level (m AOD)	75.7
Groundwater level(s) (m AOD)	No groundwater present.
Principal receptors	No groundwater present.

5.2.17 The cutting will penetrate the Kimmeridge Clay Formation which comprises unproductive strata and will not contain any significant groundwater. In summary, as there are no groundwater receptors, there will be no impact to groundwater resources. There will also be no impact to surface water/groundwater interactions, the WFD or groundwater dependent habitats.

Putlowes cutting

5.2.18 Cutting details are provided in Table 13.

Table 13: Summary of Putlowes cutting detailed groundwater assessment

Cutting parameters	Parameter details
Length (km)	0.75
Maximum depth (m)	4.1
Strata intercepted	Ampthill Clay (Unproductive strata).
Lowest track level (m AOD)	76.3
Groundwater level(s) (m AOD)	No groundwater elevation data.
Principal receptors	No groundwater present.

5.2.19 The cutting will penetrate the Ampthill Clay Formation which is unproductive strata and will not contain substantial volumes of groundwater.

5.2.20 In summary, as there are no groundwater receptors, there will be no impact to groundwater resources. There will also be no impact to surface water/groundwater interactions, the WFD or groundwater dependent habitats.

Impact to groundwater quality from deposition of stockpile adjacent to A418

5.2.21 The deposition area is approximately 30m north of the route and comprises an area of approximately 1,330m^2, although the southern part of the stockpile overlying the Portland Sand Formation comprises only460m^2. The northern half of the stockpile overlies the unproductive Kimmeridge Clay. The groundwater table is likely to be very shallow (1-2m below ground level) within the Portland Sand Formation.

5.2.22 The stockpiled area will not lie within the designated zones of travel time relating to private groundwater abstractions.

5.2.23 Suitable quality criteria for the material placed in the temporary stockpile will be defined prior to material being placed. The draft CoCP (Section 15) defines the controls and guidance that will be followed in order to obtain agreement with the Environment Agency to obtain an appropriate permit or exemption from permitting for the stockpile. The criteria will be determined to ensure that there is no significant degradation to groundwater quality as a result of the placement of material. The criteria will be agreed with the Environment Agency before placement of the material. The management of the material will be in accordance with the Contaminated Land: Applications in Real Environments (CL:AIRE) Definition of Waste: Development Industry Code of Practice[15] (as stated in the draft CoCP).

5.2.24 The material deposited in the stockpile will be natural material excavated from the cuttings in this study area and as such is unlikely to contain constituents that will adversely affect the groundwater quality. Consequently, it is considered as a generally clean, inert material. Notwithstanding this, the compliance criteria will provide a further level of security to protect groundwater quality since there will be small amounts of artificial materials remaining after centrifuging. These could comprise bentonite, polymers and other soil conditioners/plasticisers or trace leakages of hydraulic oils and greases. The compliance criteria will take into account the amount of infiltration to the stockpile or percolation under the stockpile, site drainage design and the concentrations present in samples collected from the arising. Further treatments such as cement stabilisation may be applied subsequently, depending on the eventual end use of the material.

5.2.25 It is concluded that there will be a negligible impact on groundwater quality in the Portland Sand Formation aquifer and a neutral effect.

[15] Contaminated Land: Applications in Real Environments (2011) *The Definition of Waste: Development Industry Code of Practice* (Version 2, March 2011).

6 References

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